EFFECTIVENESS OF PRE-SEEDING AND POST-SEEDING APPLICATIONS OF NITROGEN FERTILIZER FOR WHEAT AND CANOLA

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INTRODUCTION

The yield potential and response to nitrogen fertilizers of cereals and oilseed crops is strongly related to moisture conditions. Nitrogen fertilizer recommendations are based on soil test levels of available N and available moisture for crop growth. Rates of nitrogen recommended are adjusted in relation to soil moisture reserves. If the soil is dry, rates are often substantially reduced by farmers to lessen the risk of poor returns from nitrogen fertilizer.

In the northern part of Saskatchewan it is not unusual to have moisture conditions improve from fall to spring or even soon after seeding. Where nitrogen fertilizer was omitted or rates reduced because of dry conditions, and when moisture conditions improve significantly at or soon after seeding, the inadequate nitrogen supply for the improved moisture conditions could limit potential yields. Additional nitrogen could raise yields and increase the returns from fertilizer application.

Post-seeding application of nitrogen fertilizer is not a normal practice for cereals and canola production in Saskatchewan. Earlier studies in Manitoba (Dryden 1972) showed that applications of 28-0-0 N solution (combination of urea and ammonium nitrate) at rates up to 90 kg N/ha by spraying at the 2 to 4 leaf stage of growth usually produced yield increases of wheat and barley similar to those obtained when the solution fertilizer was applied pre-emergence above the seed. Granular N sources were not used for comparison. In other experiments in Manitoba, Ridley (1977) also found that when ammonium nitrate, urea and N solution 28-0-0 were applied by broadcasting without incorporation at rates of 25 and 58 kg N/ha for barley at 2 and 4 weeks after emergence, the yield and N uptake increases were similar to those obtained when the fertilizers were applied in the same way at seeding time. Urea and N solution tended to be less effective than ammonium nitrate, probably a result of loss of N as NH_3 from those sources, as the fertilizers were not incorporated at any time of application. In the above studies there were no treatments where the N fertilizers were incorporated into soil prior to seeding for comparison. It was suggested that post-seeding application of nitrogen in spring was a suitable alternative to applying the fertilizers in the fall.

The study reported on here was carried out on several soil types in Northwestern Saskatchewan to determine the effectiveness of post-seeding application of nitrogen fertilizer when compared with broadcast-incorporated N applied prior to seeding in the spring for wheat and canola.

METHODS AND MATERIALS

Ammonium nitrate 34-0-0 was used as the source of nitrogen for both pre-seeding and post-seeding spring application. Pre-seeding application consisted of broadcasting the fertilizer and incorporating to a depth of approximately 9 cm, by discing or rotovating just prior to seeding. Post-seeding applications were made by broadcasting the granular ammonium nitrate on the soil surface at certain stages of crop growth. Phosphorus was applied at a rate of 45 kg P_2O_5/ha with the seed for wheat or sidebanded for canola, using ammonium phosphate 11-55-0 in all treatments, including the 0-N check. This fertilizer supplied an additional 9 kg N/ha with all treatments. Treatments were as follows:

1) 90 kg N/ha broadcast and incorporated before seeding (BRI),
2) 45 kg N/ha BRI plus 45 kg N/ha broadcast on the surface (BR) at the 2-3 leaf stage of wheat (2-3 L) or 1 week after emergence of canola (1 wk),
3) 45 kg N/ha BRI plus 45 kg N/ha BR at the 4-5 leaf stage for wheat (4-5 L) or 2-3 weeks after emergence for canola (2-3 wk),
4) 90 BR at 2-3 leaf stage for wheat or 1 week after emergence for canola,
5) 90 BR at 4-5 leaf stage for wheat or 2-3 weeks after emergence for canola,
6) Check - 0-N.

The experiments were carried out on conventionally tilled stubble land on a black waseca loam (WaL), a dark grey Whitewood loam (WhL) and a grey luvisolic Loon River loam (LnL), during the period 1980-1983. Soil NO_3-N and $NaHCO_3$-extractable P levels determined in spring prior to seeding were low to medium, and available K and S were above critical levels.

The treatments were applied to field plots in a randomized block design with four replications. Plot size was 1.6 X 6.0 m. At maturity, four or five inner rows of crop were harvested for yield, and representative subsamples were retained for determination of protein content in both crops and oil percentage in canola seed.

RESULTS AND DISCUSSION

Spring rainfall

In all of the experiments, substantial rainfall occurred in the two-week period prior to post-seeding broadcast applications of N, and there was rain during the first week after these applications at both stages of growth.

Neepawa wheat

(a) Yields

The yield increases from nitrogen application on the different soil types are shown in Table 1. In four of the five trials, largest wheat yield increases were obtained from a split application, in which 45 kg N/ha

Table 1. Effects of pre-seeding and post-seeding application of ammonium nitrate on Neepawa Wheat.

N-kg/ha	1980 WaL	1981 LnL	1982 WhL	1983 WaL	1983 LnL	Ave.
	Yield increase over check - kg/ha					
90 BRI	829	325	436	1021	328	588
45 BRI + 45 BR 2-3 L	898	404	436	832	300	574
45 BRI + 45 BR 4-5 L	1175	457	464	1196	242	707
90 BR 2-3 L	1052	373	146	817	122	502
90 BR 4-5 L	780	295	586	760	262	537
0 (Check)	-	-	-	-	-	-
L.S.D. (P=0.05)	368	290	N.S.	384	N.S.	
	% Protein in grain (13.5% moisture)					
90 BRI	15.20	15.44		13.70	15.31	14.91
45 BRI + 45 2-3 L	15.00	14.97		14.18	14.88	14.76
45 BRI + 45 4-5 L	14.55	14.91		13.75	14.62	14.46
90 BR 2-3 L	15.18	15.15		14.36	15.12	14.95
90 BR 4-5 L	16.17	15.04		15.08	15.04	15.33
0 (Check)	11.83	11.92		10.73	12.35	11.71
L.S.D. (P=0.05)	1.35	.84		1.29	1.50	

BRI - broadcast and incorporated before seeding
BR - broadcast on soil surface without incorporation

Table 2. Effect of pre-seeding and post-seeding application of ammonium nitrate on Canola.

N-kg/ha	1980 WaL Regent	1981 WaL Regent	1981 LnL Regent	1983 WaL Westar	Ave.
			Yield increase over check - kg/ha		
90 BRI	244	289	195	243	243
45 BRI + 45 BR 1 wk	247	250	438	275	302
45 BRI + 45 BR 2-3 wk	263	252	284	221	255
90 BR 1 wk	191	248	317	234	248
90 BR 2-3 wk	59	219	202	117	149
0 (Check)	-	-	-	-	-
Sig. diff. (P=0.05)	187	108	N.S.	179	
			% Oil in seed (O.D.B.)		
90 BRI	44.50	41.64		41.32	42.49
45 BRI + 45 BR 1 wk	44.35	41.49		41.17	42.34
45 BRI + 45 BR 2-3 wk	43.88	40.97		41.51	42.12
90 BR 1 wk	43.37	41.75		40.99	42.04
90 BR 2-3 wk	43.01	41.85		41.12	41.99
0 (Check)	48.48	43.89		46.22	46.20
Sig. diff. (P=0.05)	2.61	.71		1.37	
			% Protein in seed (8.5% moisture)		
90 BRI	22.87	23.61		24.21	23.56
45 BRI + 45 BR 1 wk	22.54	23.46		23.70	23.23
45 BRI + 45 BR 2-3 wk	23.16	25.39		23.99	24.18
90 BR 1 wk	23.05	23.16		23.84	23.35
90 BR 2-3 wk	24.01	25.43		24.77	24.74
0 (Check)	19.14	22.04		17.59	19.59
Sig. diff. (P=0.05)	1.02	1.84		1.86	

(a) Yields (cont'd)

was broadcast and incorporated before seeding, and an equal amount broadcast on the soil surface at the 4-5 leaf stage. This treatment was generally more effective than broadcasting and incorporating all of the N fertilizer (90 kg N/ha) before seeding in spring. Average yield increases from applying all of the N after crop emergence were slightly lower than from the split applications or pre-seeding application.

(b) Protein content

Without N fertilizer, protein contents in wheat varied from 10.73 to 12.35%. All N fertilizer treatments increased protein contents in grain above 13.5%, with little difference between treatments.

Canola

(a) Yields

Responses of canola are shown in Table 2. Canola yields and yield increases from ammonium nitrate fertilizer treatments were relatively low because of stand establishment problems and moderate weed infestations. The split N treatments produced the highest average yield increases , but the differences between N treatments were relatively small, except for the treatment in which 90 kg N/ha was surface broadcast 2-3 weeks after emergence of the crop, which consistently resulted in the lowest yield increases.

(b) Oil content in seed

All N treatments significantly reduced % oil in the seed but differences between treatments were small.

(c) Protein content in seed

Protein levels in the seed were substantially increased by N application, and the increases were proportional to the decreases in oil content.

Ammonium nitrate appears to be quite effective as a post-emergence N fertilizer for spring wheat and canola grown in areas with favorable moisture conditions, especially when used in a split application with the post-emergence portion broadcast at the 4-5 elaf stage of wheat or 2-3 weeks after emergence of canola. This N source is currently recommended for application in the spring on winter wheat sown on stubble land in Saskatchewan. There are indications that ammonium nitrate may not be readily obtainable from fertilizer dealers in the future. Although urea was not evaluated for post-seeding broadcast application, rates would likely have to be increased to compensate for possible losses of N through volatilization of ammonia when surface applied.

REFERENCES

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